

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
15 July 2004 (15.07.2004)

PCT

(10) International Publication Number
WO 2004/059394 A3

(51) International Patent Classification⁷: **G03F 7/20**
(21) International Application Number:
PCT/IB2003/006094

(22) International Filing Date:
18 December 2003 (18.12.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
02080594.1 30 December 2002 (30.12.2002) EP

(71) Applicant (for all designated States except US): **KONINKLIJKE PHILIPS ELECTRONICS N.V.** [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **VAN WINGERDEN, Johannes** [NL/NL]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). **JUFFERMANS, Casparus, A., H.** [NL/NL]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). **DIRKSEN, Peter** [NL/NL]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(74) Agent: **DUIJVESTIJN, Adrianus, J.**; Philips Intellectual Property & Standards, Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

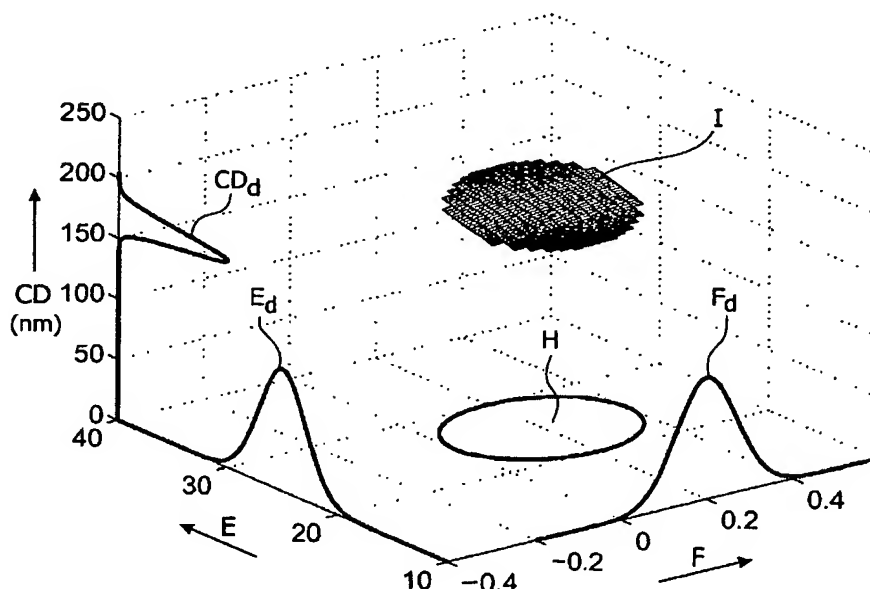
(84) Designated States (*regional*): ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ,

[Continued on next page]

(54) Title: DETERMINING LITHOGRAPHIC PARAMETERS TO OPTIMISE A PROCESS WINDOW



(57) Abstract: For determining best process variables (E, F, W) setting that provide optimum process window for a lithographic process for printing features having critical dimensions (CD) use is made of an overall performance characterizing parameter (C_{pk}) and of an analytical model, which describes CD data as a function of process parameters, like exposure dose (E) and focus (F). This allows calculating of the average value (μCD) and the variance (σCD) of the statistical CD distribution (CDd) and to determine the highest C_{pk} value and the associated values of process parameters, which values provide the optimum process window.



CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:
16 September 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 03/06094

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G03F7/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G03F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2002/085297 A1 (BOWES STEVE W ET AL) 4 July 2002 (2002-07-04) abstract paragraphs '0006!, '0007!, '0009!, '0022!; claims 1,2	1,2,5-11 3,4
X A	MANAKLI S ET AL: "Combination multiple focal planes and PSM for sub 120 nm node with KrF lithography: study of the proximity effects" MICROELECTRONIC ENGINEERING, ELSEVIER PUBLISHERS BV., AMSTERDAM, NL, vol. 61-62, July 2002 (2002-07), pages 123-132, XP004360524 ISSN: 0167-9317 Chapter 3 abstract	1,2,5-11 3,4

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- * & * document member of the same patent family

Date of the actual completion of the international search

22 July 2004

Date of mailing of the international search report

29/07/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Thiele, N

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 03/06094

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 01/84382 A (KLA TENCOR INC) 8 November 2001 (2001-11-08) page 2, line 24 - page 3, line 9 page 6, line 35 - page 7, line 6 page 9, lines 25-36 page 10, line 30 - page 11, line 2 page 13, lines 4-12 page 14, lines 23-34; claims 1,2,8,9,27	1,2,5-11 3,4
X A	MACK C A ET AL: "Data Analysis for Photolithography" MICROELECTRONIC ENGINEERING, ELSEVIER PUBLISHERS BV., AMSTERDAM, NL, vol. 46, no. 1-4, May 1999 (1999-05), pages 65-68, XP004170669 ISSN: 0167-9317 page 67, column 2, lines 1-38	1,2,5-11 3,4
P,Y P,A	EP 1 271 246 A (INFINEON TECHNOLOGIES AG) 2 January 2003 (2003-01-02) paragraphs '0007!, '0025!, '0034!; claims 1,2,5-8,11	1,2,5-11 3,4
Y A	US 6 272 392 B1 (CAPODIECI LUIGI) 7 August 2001 (2001-08-07) claims 1,6,7,14,15; figures 4-6	1,2,5-11 3,4
Y A	US 6 478 484 B1 (SINGH BHANWAR) 12 November 2002 (2002-11-12) column 6, line 58 - column 7, line 33; claims 1,2,5,7; figure 3	1,2,5-11 3,4
A	US 2002/131040 A1 (NIU XINHUI ET AL) 19 September 2002 (2002-09-19) claims 1-7	1-11
A	US 5 790 254 A (AUSSCHNITT CHRISTOPHER PERRY) 4 August 1998 (1998-08-04) the whole document	1-11
P,A	WO 03/032381 A (SCHMIDT SEBASTIAN ; MATTIZA DIANA (DE); BROERMANN OLIVER (DE); INFINEO) 17 April 2003 (2003-04-17) claims 1-10	1-11

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 03/06094

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2002085297	A1	04-07-2002	US 6545829 B1 US 2002041369 A1	08-04-2003 11-04-2002
WO 0184382	A	08-11-2001	JP 2003532306 T WO 0184382 A1 US 2003148198 A1 US 2004005507 A1 US 2002072001 A1	28-10-2003 08-11-2001 07-08-2003 08-01-2004 13-06-2002
EP 1271246	A	02-01-2003	EP 1271246 A1 TW 550722 B US 2003039905 A1	02-01-2003 01-09-2003 27-02-2003
US 6272392	B1	07-08-2001	NONE	
US 6478484	B1	12-11-2002	NONE	
US 2002131040	A1	19-09-2002	US 2003133104 A1 JP 2002334913 A TW 519746 B	17-07-2003 22-11-2002 01-02-2003
US 5790254	A	04-08-1998	US 5629772 A WO 9849538 A1	13-05-1997 05-11-1998
WO 03032381	A	17-04-2003	DE 10147880 A1 WO 03032381 A2	10-04-2003 17-04-2003